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JUNE, 1959

Infra-red
filter materials
& transmission curves

KODAK
IRTRAN OPTICS

DIVISION 7
OCT 19 1960
U. S. PATENT OFFICE

EASTMAN KODAK COMPANY

Apparatus and Optical Division

Rochester 4, N. Y.

359/359

O.L.

KODAK IRTRAN OPTICS

Type AB-1, first of a new family of infrared-transmitting materials,

- costs less (sometimes much less) than previously available materials for the 1- to 8-micron region
- transmits, in structurally adequate thickness, more than 90% of impinging energy from 3 to 6 microns
- withstands severe heating, thermal shock, weathering, humidity, and abrasion
- retains high transmittance at 800°C and beyond, defeating the emissivity of "hot windows"
- wastes little energy by reflection
- stands close to natural mica for microwave transmittance in the 9- to 10-kilomegacycle range
- *can be readily molded, ground, and polished into lenses, domes, prisms, flats, and substrates for interference filters*

Specifications for quotation should be submitted to

EASTMAN KODAK COMPANY

Special Products Sales • Apparatus and Optical Division

Rochester 4, N. Y.

(LOcust 2-6000, Ext. 5166)

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Kodak
TRADE MARK

15 June 59

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APPARATUS & OPTICAL DIVISION
EASTMAN KODAK CO.
ROCHESTER 4, N. Y.

Technical Data

KODAK IRTRAN AB-1 OPTICAL MATERIAL

Melting Point – 1396° C (2548 F)

Density – 3.18 grams/cc

Hardness – 576 Knoop (about 6 moh)

Specific Heat – 0.22 cal/gm/° C

Thermal Conductivity – 7.5×10^{-3} cal/cm^2/sec/° C/cm

Expansion Coefficient –

Temperature Range°C	*Coefficient**
25 – 100	8×10^{-6}/° C
25 – 200	12×10^{-6}/° C
25 – 300	14×10^{-6}/° C
25 – 400	16×10^{-6}/° C
25 – 500	16.5×10^{-6}/° C
25 – 600	17×10^{-6}/° C

Refractive Index –

Wavelength (microns)	*Refractive Index at 25° C***
1.0140	1.3776
1.5295	1.3747
2.1526	1.3708
2.4374	1.3688
3.3033	1.3609
3.4188	1.3594
4.253	1.3489
4.866	1.3402
5.136	1.3348
6.238	1.3122

Weathering – No measurable effect from MIL Std. 305 (temperature cycling with high humidity).

*Repetitive measurements from two samples averaged for each temperature range indicated.

**Average data obtained from two sample prisms (44°-43'-45" and 40°-16'-15"). Refractive index readings between samples agree within ± .0001.

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Thermal Shock –

A. Samples of .080" thick material in .800" diam. circular flats and 2" hemispherical domes have survived water quench tests from 125°C to ambient water temperature.

B. Samples of .080" thick material formed in steel rings have survived quench tests from ambient temperature to liquid nitrogen at -190°C.

C. Samples of .080" thick material formed in steel rings have survived quench tests from dry ice at -80°C to hot oil at 230°C.

Bonding to Metals –

A. Flat circular discs can be hermetically molded to a surrounding stainless steel ring.

B. Rectangular windows and domes can be bonded to metal using ceramic frits and other ceramic-to-metal techniques.

Microwave Characteristics –

A. The reflection characteristics of an untuned Irtran AB-1 window in the frequency range 9-10 KMC are superior to those of a similar window fabricated of natural mica.

B. The insertion loss of an untuned Irtran AB-1 window in the frequency range 9-10 KMC is less than that of a similar window fabricated of natural mica.

Transmittance and Emissivity –

Fig. 1 illustrates specular transmittance and emissivity at temperatures of 26°C, 400°C, 600°C, and 800°C of a 1.75mm thick early Irtran AB-1 material sample. Actual emissivity in the 1.5-3.5 micron region may be lower than measured data shown because of scattered energy in this region.

Fig. 2 illustrates typical specular transmittance for a 2.85mm thick Irtran material sample showing reduced scatter at short wavelengths.

Fig. 3 compares specular transmittance of 3mm thick samples of Irtran AB-1 material and sapphire at 25°C.

Fig. 4 illustrates typical specular transmittance of Irtran AB-1 material in two separate samples, 0.25mm and 2.5mm thick.

Fig. 5 illustrates total, diffuse, and specular transmittance of the same Irtran material sample measured for Fig. 2.

Fig. 6 compares specular transmittance and emissivity at 800°C of Irtran AB-1 material, sapphire and periclase samples. (Variations in sample thicknesses should be noted. Sapphire data are given for only available sample at time of report preparation.)

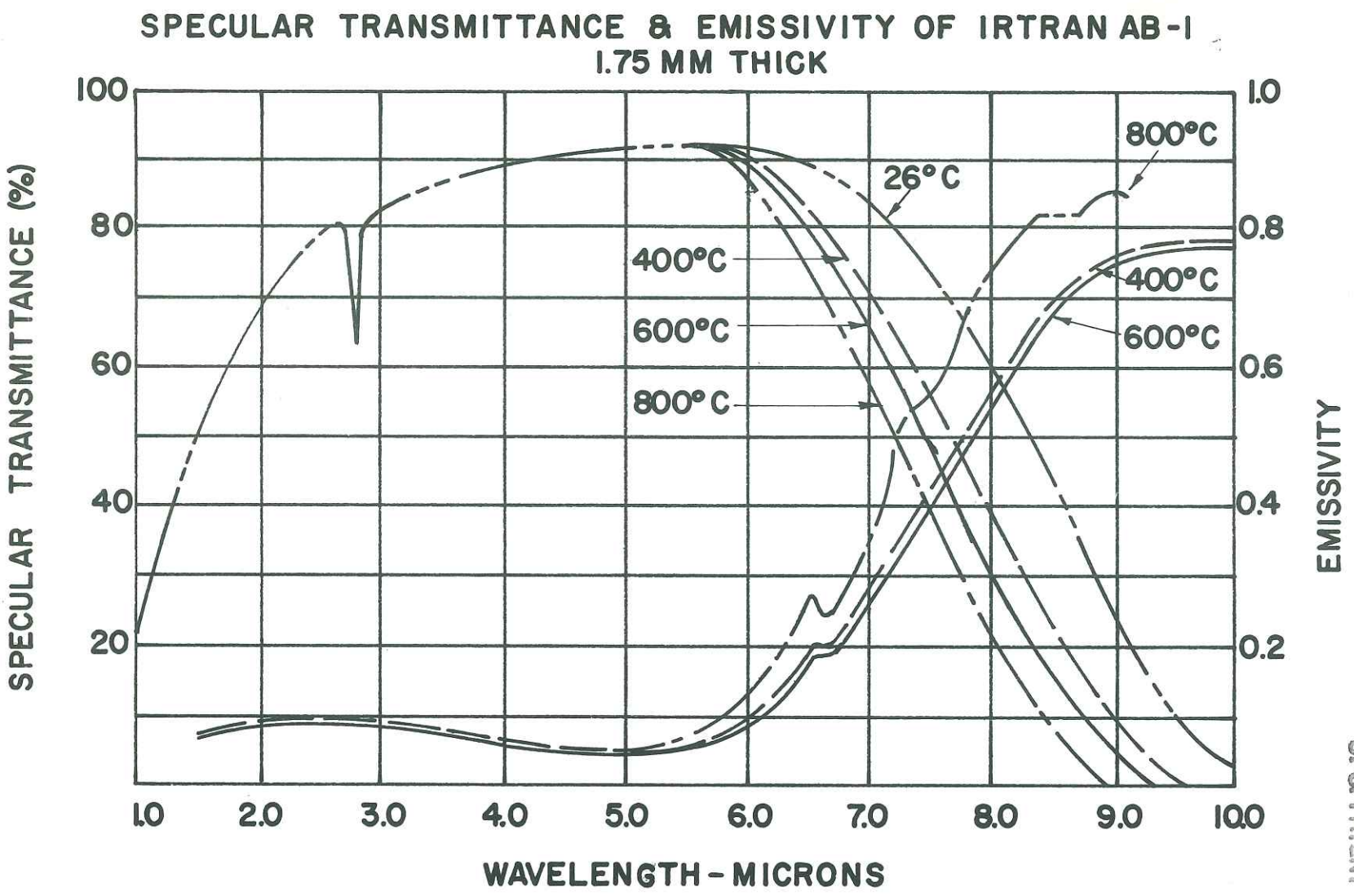

FIGURE 1

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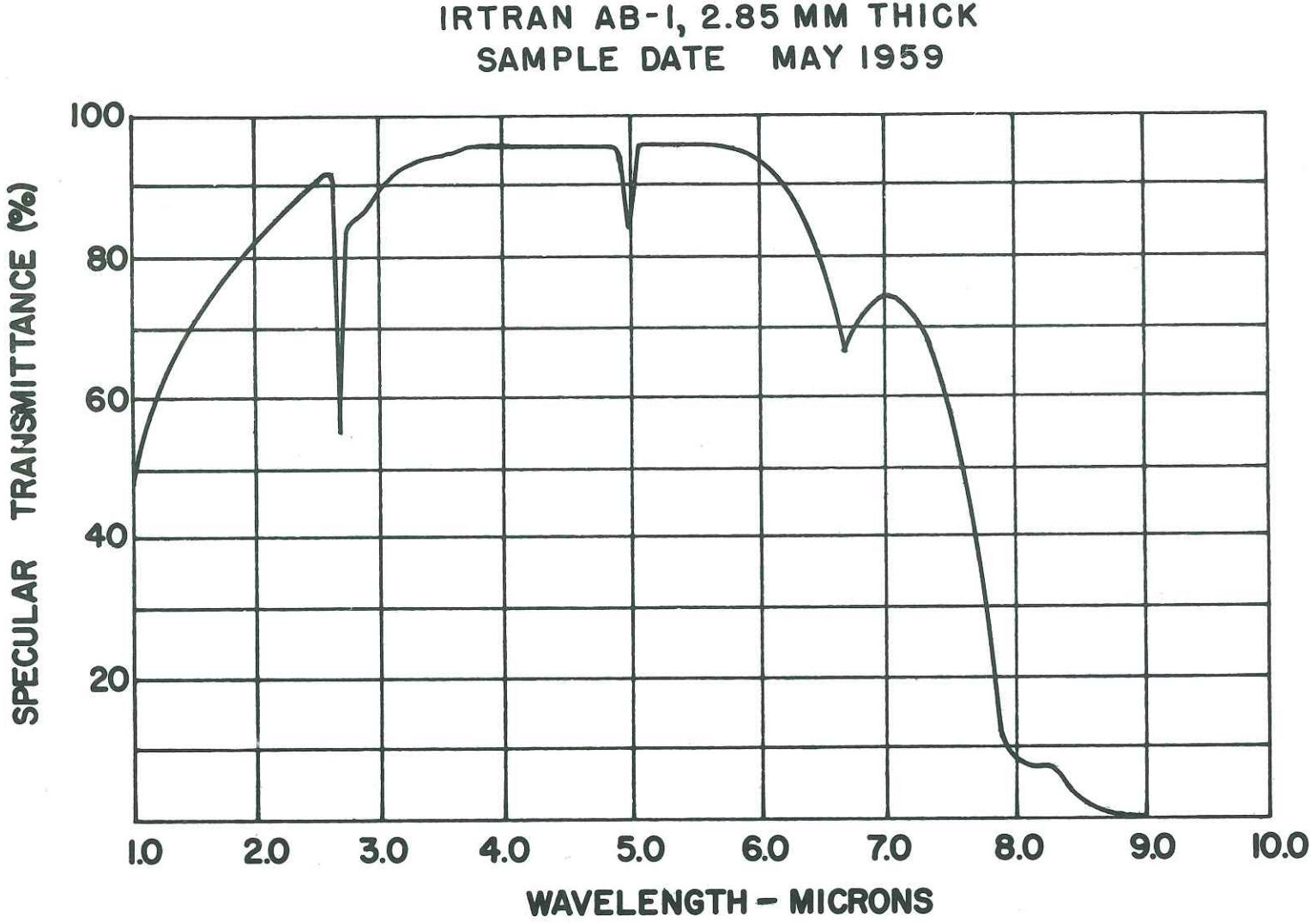
IRTRAN AB-1, 2.85 MM THICK
SAMPLE DATE MAY 1959
SPECULAR TRANSMITTANCE (%)
100
80
60
40
20
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
WAVELENGTH – MICRONS

FIGURE 2

SPECULAR TRANSMITTANCE OF IRTRAN AB-I AND SAPPHIRE
BOTH SAMPLES 3 MM THICK

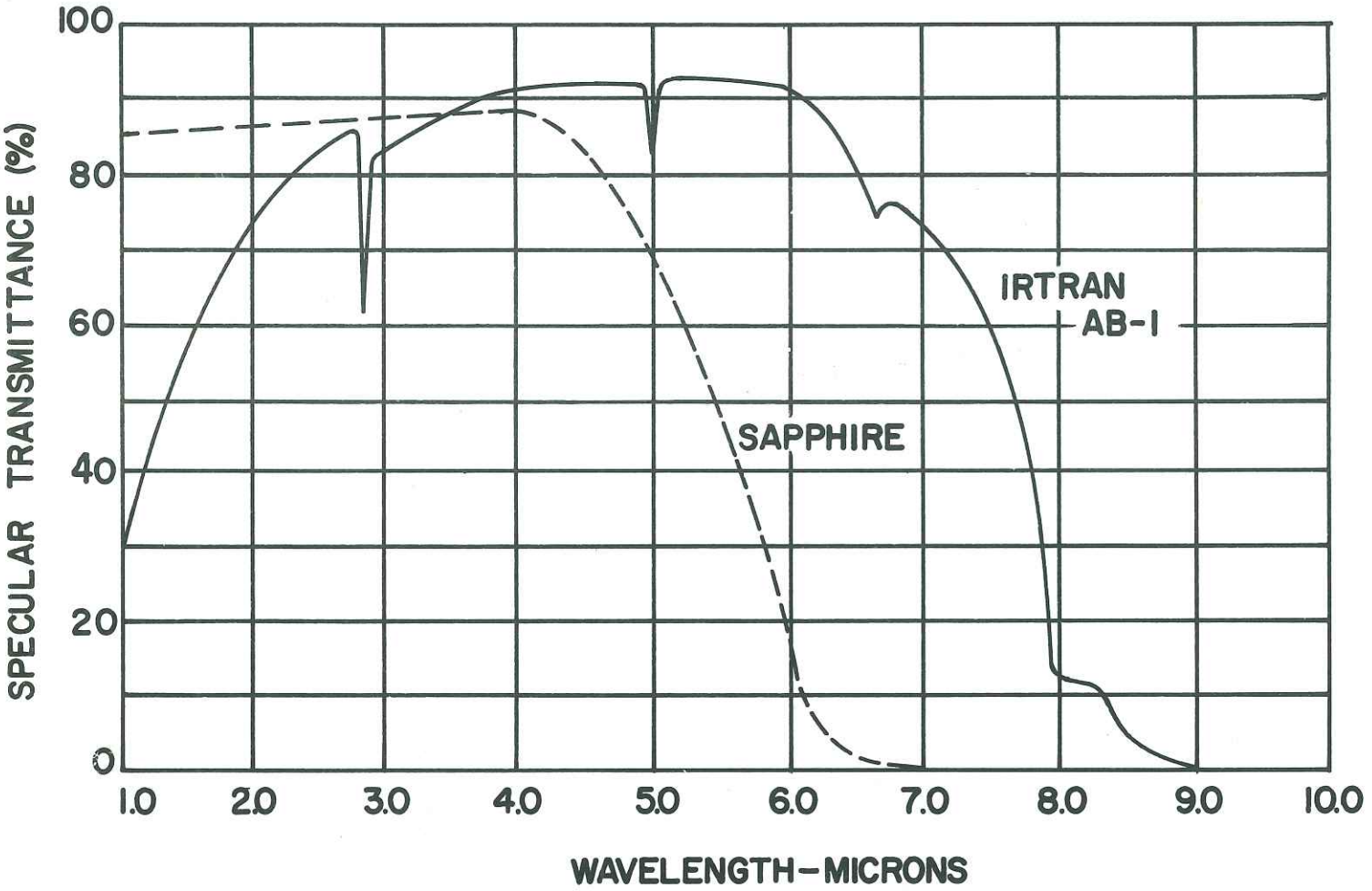

FIGURE 3

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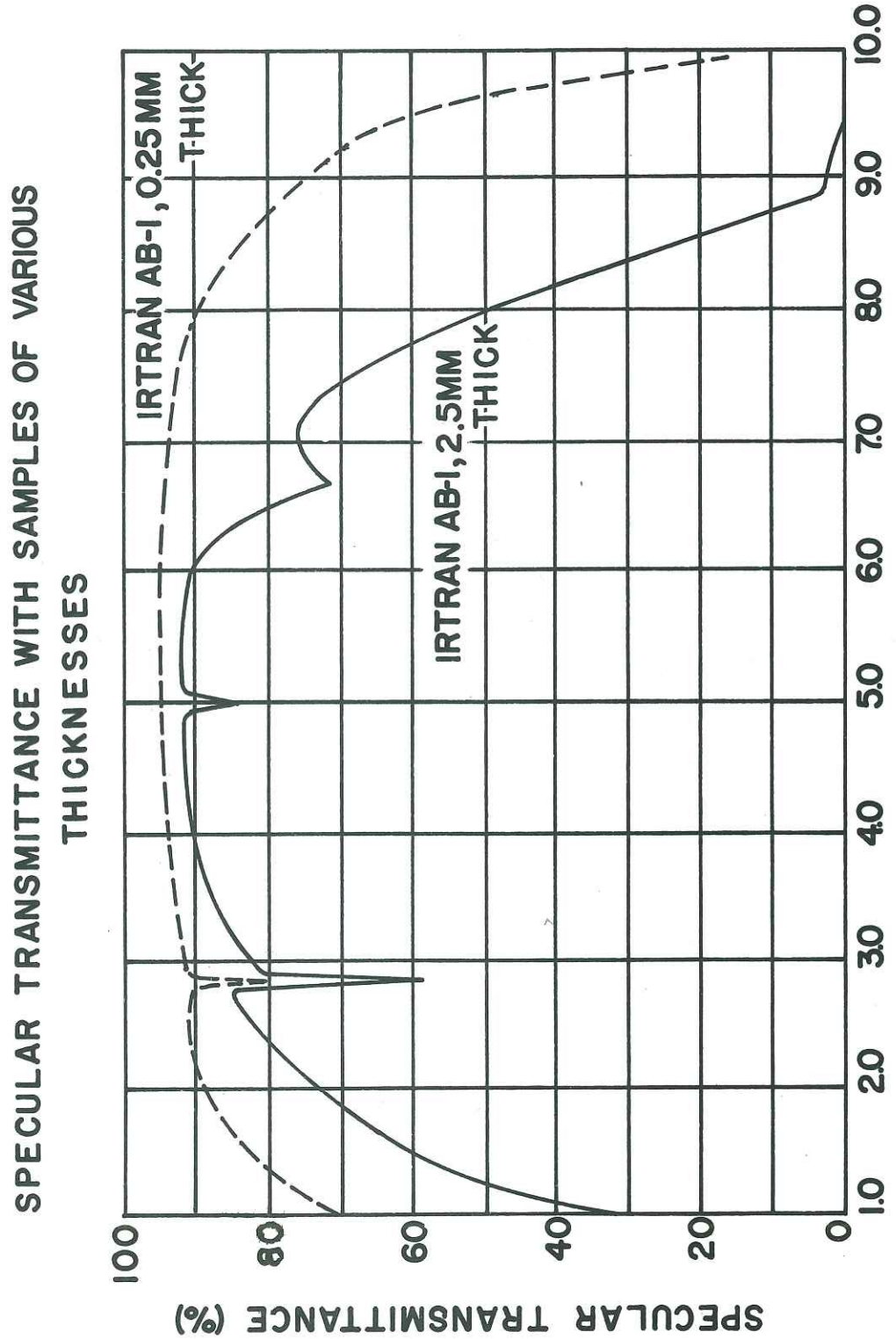

FIGURE 4

TOTAL, SPECULAR, & DIFFUSE TRANSMITTANCE
OF SAMPLE IN FIGURE 2

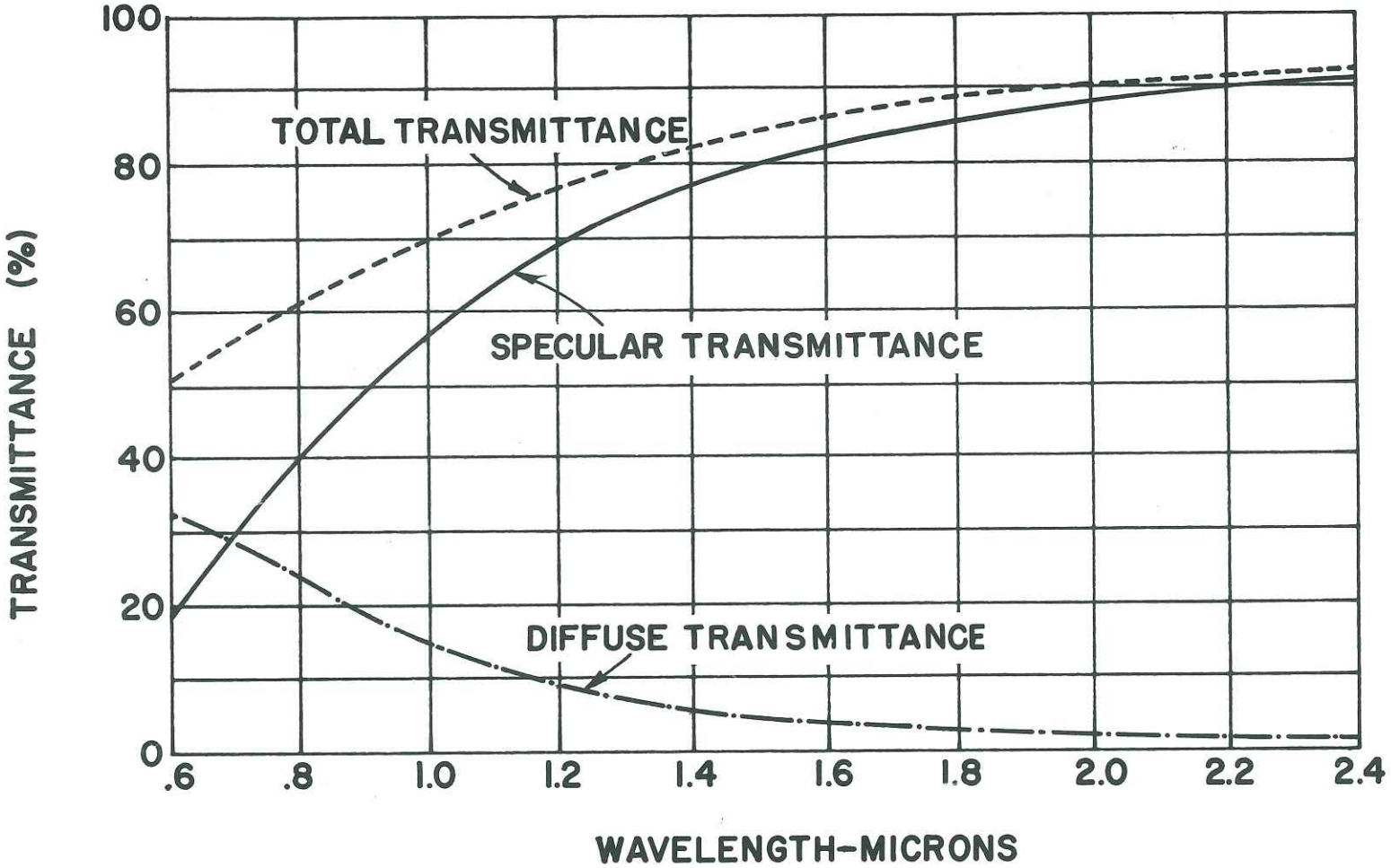

FIGURE 5

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SPECULAR TRANSMITTANCE AND EMISSIVITY AT 800°C
IRTRAN AB-1, 1.75 MM THICK
PERICLASE, 1.75 MM THICK
SAPPHIRE, 4.0 MM THICK (ONLY AVAILABLE SAMPLE)

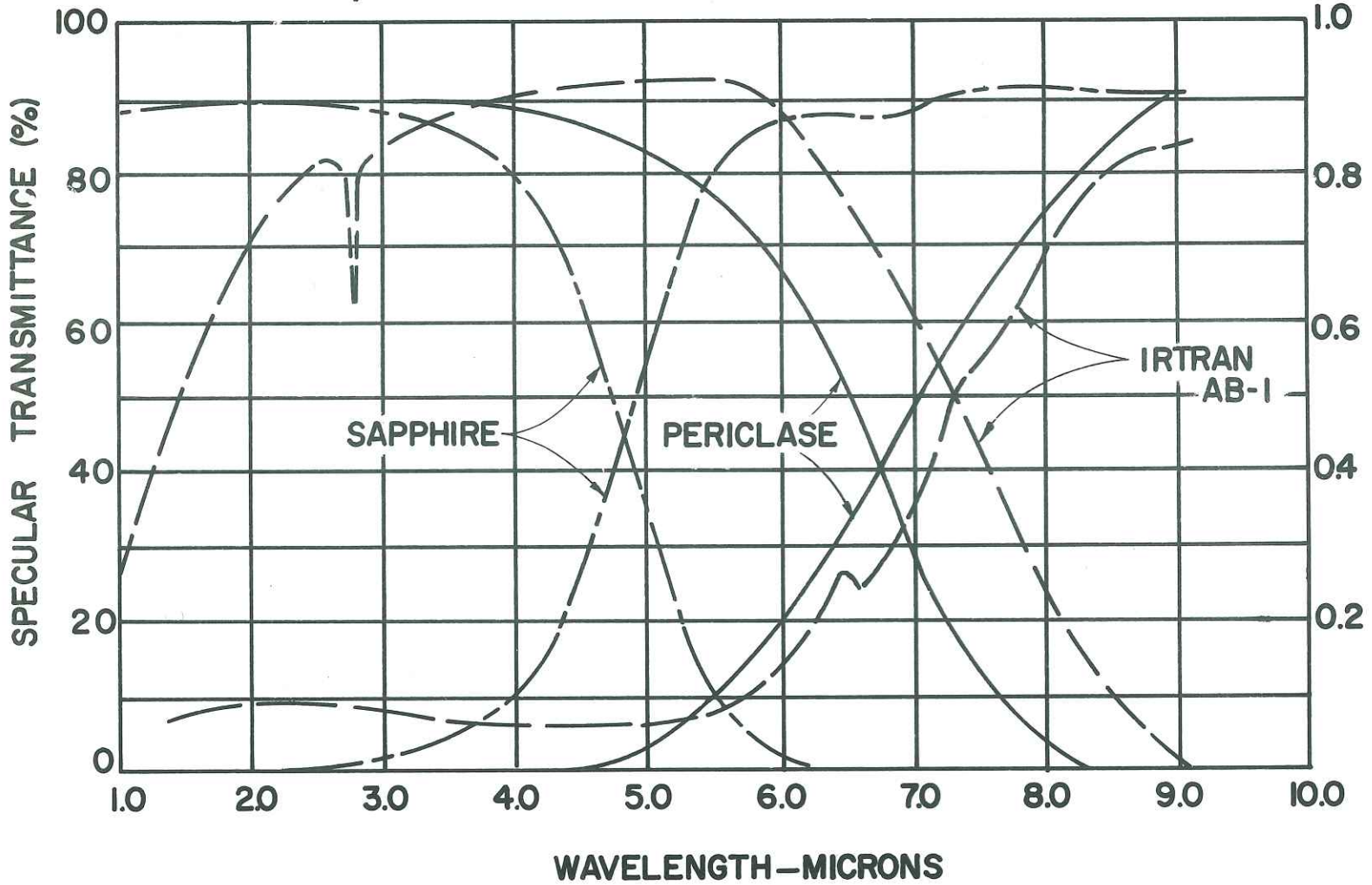

FIGURE 6

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Apparatus and Optical Division
EASTMAN KODAK COMPANY
Rochester 4, New York

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KODAK IRTRAN ABC-II OPTICAL MATERIAL

Preliminary Data Release

Useful Temperature Range - -200°C. to +800°C.

Density - 4.11 gms/c.c.

Expansion Coefficient -

Temperature Range °C.	Coefficient $\frac{1}{L}\frac{\Delta L}{\Delta T}$
25 - 300	7.3×10^{-6}
25 - 402	7.94×10^{-6}
25 - 582	8.37×10^{-6}
25 - 702	8.57×10^{-6}
25 - 809	8.63×10^{-6}
25 - 905	9.05×10^{-6}

Refractive Index -

Wavelength (microns)	Refractive Index at 25°C.
1.0140	2.2897
1.5295	2.2700
2.1526	2.2616
2.5	2.2590
3.0	2.2559
3.4188	2.2535
4.0	2.2501
5.0	2.2445
6.0	2.2383
7.0	2.2304
8.0	2.2212
9.0	2.2107
10.0	2.1983
11.0	2.1849
12.0	2.1689
13.0	2.1507

IRTRAN ABC-II, 1.5MM. THICK

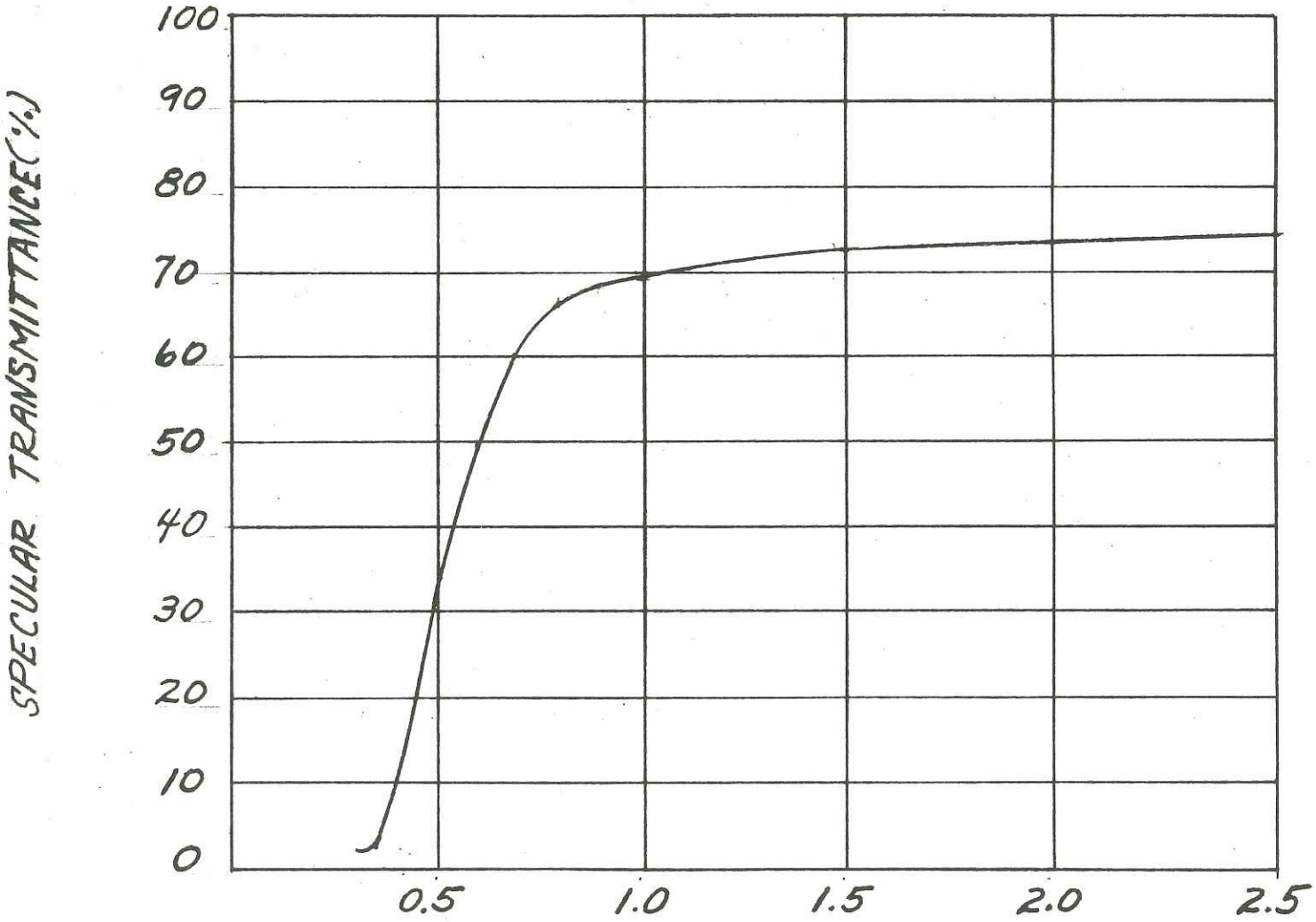

FIGURE I 3/60

IRTRAN ABC-II, 2.00MM. THICK

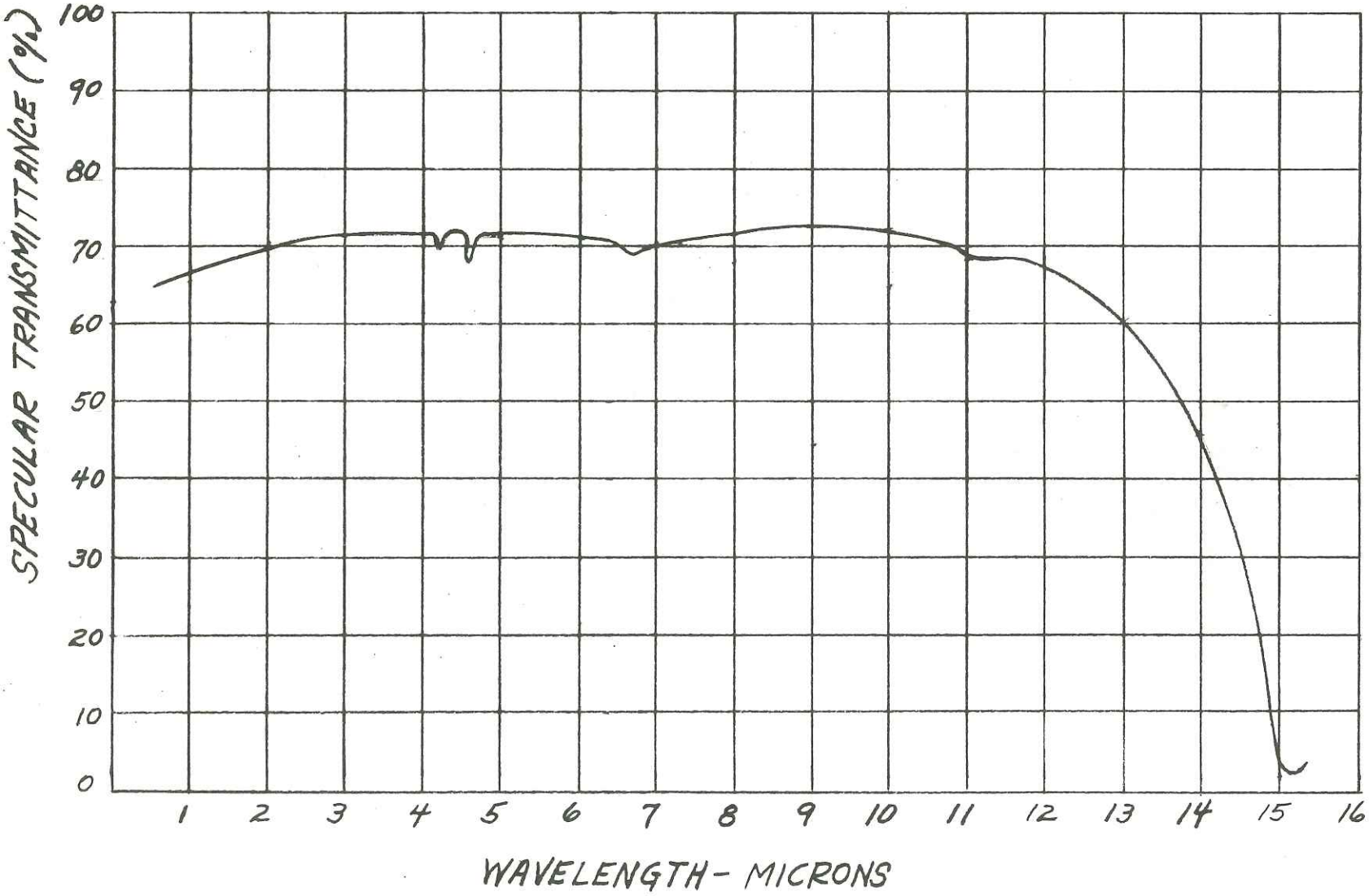

FIGURE II 3/60

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EASTMAN KODAK COMPANY

Rochester, New York

KODAK FAR INFRARED FILTERS

Kodak Far Infrared Filters are intended to fill a need for a broad-window blocking filter having various cut-on points in the infrared spectrum. Selection of the best filter characteristics for your purposes can be made from the following lists and from the transmission curves on Pages 4 and 5.

Standard "cut-ons" are supplied between 1 and 5 microns, in 0.5 micron steps, with a tolerance of plus or minus 0.2 microns. Our cut-on point is defined as the wavelength at which transmission reaches 3%. For order simplification and easy identification, filters of various cut-ons are designated as follows:

Series No.	Micron Cut-on
210	1
215	1.5
220	2
225	2.5
230	3
235	3.5
240	4
245	4.5
250	5

Kodak Far Infrared Filters are prepared by applying suitable coatings to both sides of silver chloride substrate. The filter coating used is delicate, and may be damaged with only light scuffing or abrasion. It is recommended that the filters be considered for applications only where no cleaning is required, or where a gentle air blast (such as from a syringe) can be used. These filters are not recommended for use in outdoor weather conditions, except where infrared-transmitting protective windows are employed.

If physical handling or cleaning of Kodak Far Infrared Filters is considered periodically necessary, an additional protective plastic coat of polystyrene is sometimes desirable. Filters may be ordered with or without polystyrene coating, at no difference in price. If polystyrene-coated filters are considered, attention is called to the characteristic polystyrene absorption "dips" in the transmission curves. Unless otherwise specified, the polystyrene coating will be applied to any filters ordered. When identifying polystyrene-coated filters, the suffix "S" is added to the series number.

Silver chloride has the usual chloride-compound affinity for hygroscopic attraction of water. Hence, silver chloride substrate, under normal humidity variations, can cause corrosion of commonly used filter cell mount metals, as well as filter deterioration. Therefore, cell mount materials should be selected to resist saline corrosion. In general, most plastics will be quite adequate. Where metal mounts are absolutely necessary, the polystyrene-coated filters offer greater corrosion resistance than do the unprotected filters.

The following prices apply to the series, sizes, and quantities indicated:

Series 210 through 230, and
Series 210S through 230S.

Standard Sizes	1 Filter	2 or 3 Filters, Per Filter	4 or more Filters, Per Filter
1 x 1", or 1" diameter	$ 62.00	$ 37.00	$ 28.50
2 x 2", or 2" "	68.00	43.00	33.00
3 x 3", or 3" "	97.00	72.00	61.50
4 x 4", or 4" "	125.00	100.00	92.50
5 x 5", or 5" "	161.00	136.00	128.50

Series 235 through 250, and
Series 235S through 250S.

Standard Sizes	1 Filter	2 or 3 Filters, Per Filter	4 or more Filters, Per Filter
1 x 1", or 1" diameter	$ 78.00	$ 47.00	$ 34.50
2 x 2", or 2" "	84.00	53.00	39.00
3 x 3", or 3" "	113.00	82.00	66.00
4 x 4", or 4" "	141.00	110.00	100.00
5 x 5", or 5" "	177.00	146.00	136.00

Prices are based on supplying filters within the following standard specifications:

Standard Linear Size Tolerance

Plus or minus 2% up to a maximum tolerance of plus or minus .050".

Standard Thickness

Up to 2.5" square or round, .040" thick
From 2.5" to 5" diameter, .080" thick
Tolerance plus or minus 10%

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SPECIAL FILTERS

Round Filters....in non-standard sizes up to 3" diameter are priced the same as the square size from which they can be cut, plus a premium of $30.00 per order.

Square or Rectangular Filters....are supplied in minimum size of 1/2" x 1/2". In rectangular filters, maximum length-to-width ratio is 5:1 (up to maximum dimension of 5"). Non-standard square or rectangular filters are priced at the price of the next largest standard square filter from which they can be cut.

Requirements for any single size Kodak Far Infrared Filter in quantities of 25 or more will be quoted on a special basis.

All prices above are net 30 days, f.o.b. Rochester, no Federal Excise Tax, no cash discount, subject to state and local taxes if applicable. Prices are subject to change without notice.

Orders and requests for additional information should be addressed to:

EASTMAN KODAK COMPANY
Special Products Sales
400 Plymouth Avenue North
Rochester 4, New York

Telephone: LOcust 2-6000
Extensions 5166 or 4212 or 2183

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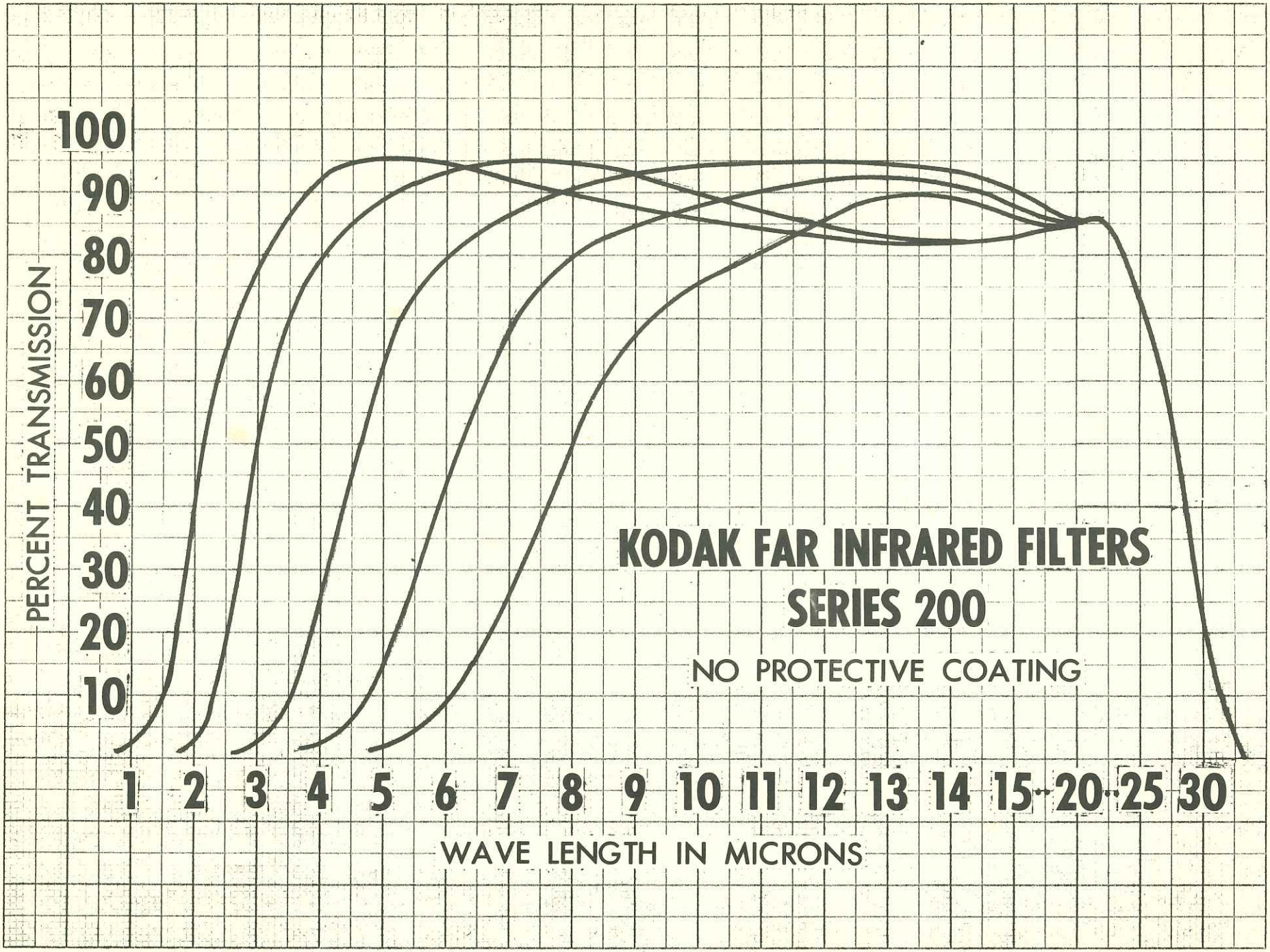
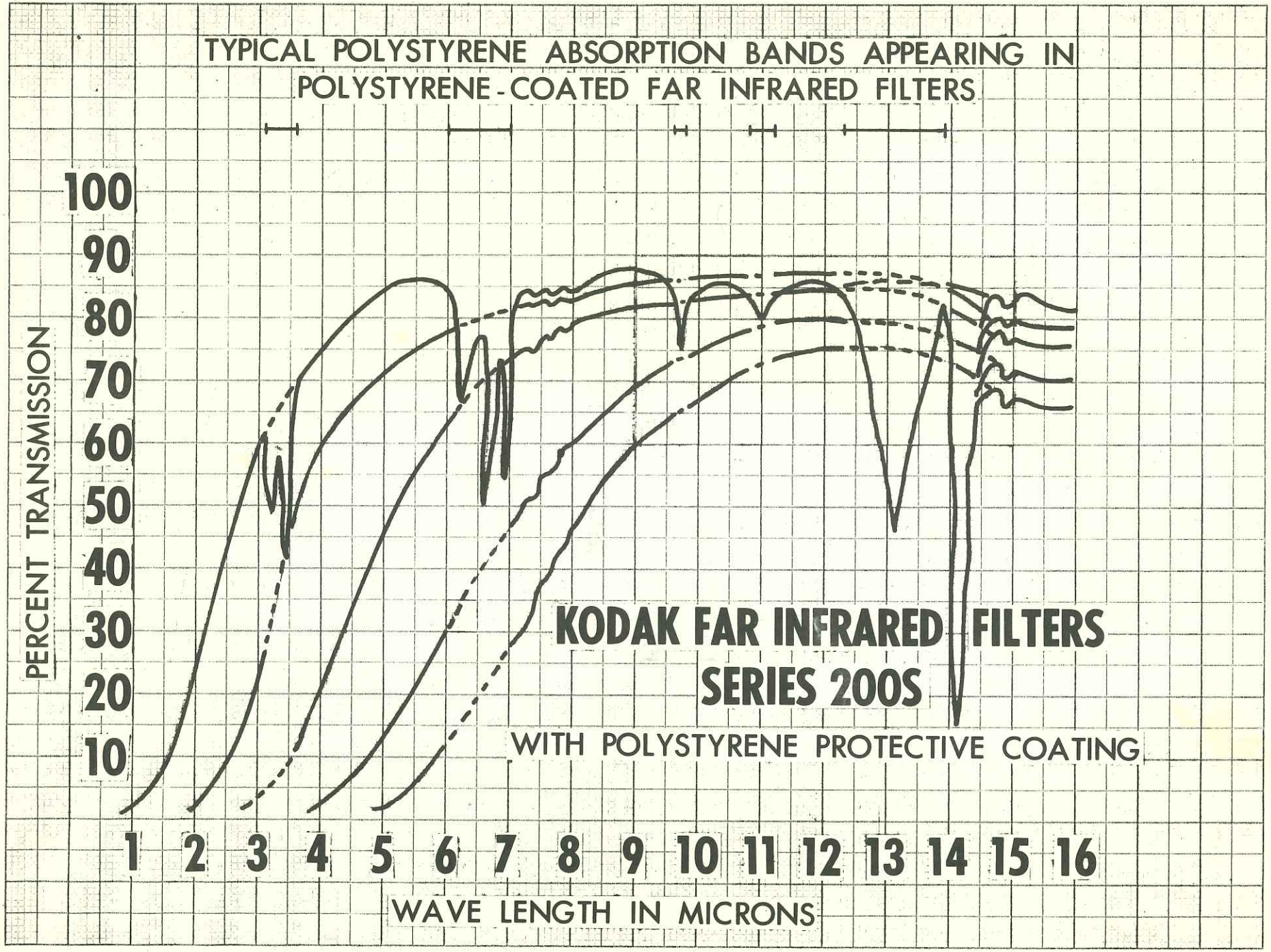


KEUFFEL & ESSER CO. N. Y.



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